HW11, 2024

Electronegativity is a relative ability of atoms to attract electrons while binding to other atoms. It is an ability to polarize a covalent bond.

The difference in electronegativities of atoms defines the nature of the bond between them. For mostly covalent bond the difference is < 0.4, for polar it is between 0.4 and 2, and for ionic bonds it is >2. The table below gives electronegativities of different atoms.

E.g. the bond in O=O molecule is covalent: 3.44-3.44 = 0, the bond in H-F molecule is polar covalent: 3.98-2.2 = 1.78, and the bond K-O in K_2O is ionic: 3.44-0.82=2.62

Electronegativity:

Element	Electronegativity	Element	Electronegativity
Cs	0.79	H	2.20
K	0.82	C	2.55
Na	0.93	S	2.58
Li	0.98	I	2.66
Ca	1.00	Br	2.96
Mg	1.31	N	3.04
Be	1.57	Cl	3.16
Si	1.90	O	3.44
B	2.04	F	3.98
P	2.19		

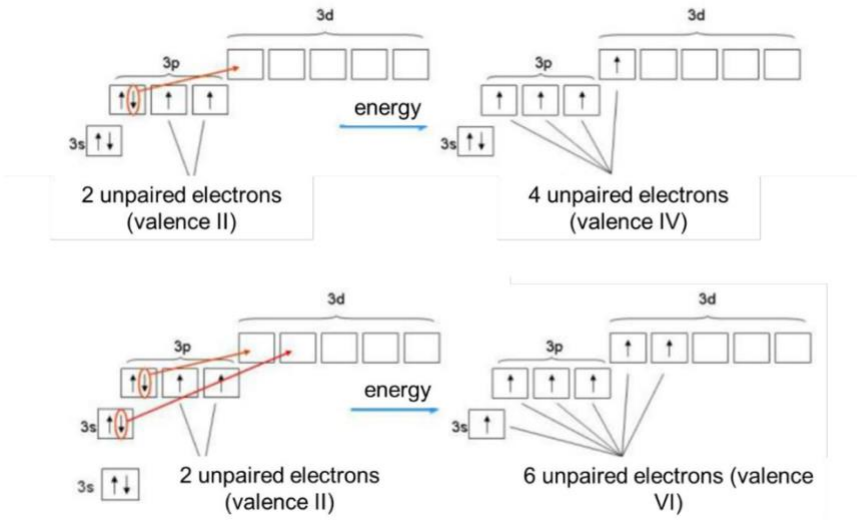
The valence is the number of electron pairs that binds the atom with other atoms. For some common elements it may be useful to remember their valences. The table below gives valences of some common elements. (The numbers in parentheses show possible valences for elements that may exhibit more than a single valence.)

Valences of some common elements

Element	Valence	Element	Valence
H	I	Ba	II
Na	I	O	II
K	I	Zn	II
Ag	I	Sn	II (IV)
F	I	Pb	II (IV)
Cl	I (III, V, VII)	Fe	II, III
Br	I (III, V, VII)	Cr	III, VI
I	I (III, V, VII)	S	II, IV, VI
Hg	I, II	Al	III
Cu	I, II	N	III (IV)
Be	II	P	III, V
Mg	II	C	IV
Ca	II	Si	IV (II)

The valence can be used to write down chemical formulas. E.g. if we want to write down the formula of Fe (III) compound with oxygen (iron oxide) we can write down the elements symbol with their valences on top and then move the valences to the opposite elements as their indexes:

If given an additional energy an atom can get into an excited state from the ground state where the energy is at its minimum. In the excited state electrons can unpair and move to different orbitals within the same shell increasing the valency of the atom. For example, sulfur ($_{16}$S) can have valences II, IV, and VI by transferring one or two electrons to 3d orbitals:



The energy necessary to unpair electrons and increase the valence may be compensated by formation of more molecular bonds with the excited atom.

Example of the chemical formula, potassium chloride we write as KCl, and structural formula we write as K – Cl.

Questions

1. Determine the nature of the bond and put the compounds below into one of the following three groups: a) with covalent bonds; b) with polar covalent bonds; c) with ionic bonds

PH_3, CaO, Br_2, $BeCl_2$, CsBr, S_8, BF_3, H_2, Li_2O

2. Using valences of elements write down chemical formulas of a) calcium with fluorine, b) magnesium with oxygen, c) aluminum with oxygen.
3. Determine the valence of each atom in a) HCl, b) $BeCl_2$, c) $AlBr_3$, d) PH_3.
4. Predict if $_{34}$Se element can have one or multiple valences using its outer shell configuration.